DELAWARE RIVER BASIN
TRIBUTARY TO HAYNES CREEK
BURLINGTON COUNTY
NEW JERSEY

LAKE STOCKWELL DAM
NJ 00422

PHASE 1 INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

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DEPARTMENT OF THE ARMY
Philadelphia District
Corps of Engineers
Philadelphia, Pennsylvania

FEBRUARY 1980

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Copies are obtainable from National Technical Information Service, Springfield, Virginia 22151.

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Dams	National Dam Safety Program
Embankments	Lake Stockwell Dam, New Jersey
Visual Inspection	Spillways
Structural Analysis	Erosion

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This report cites results of a technical investigation as to the dam's adequacy. The inspection and evaluation of the dam is as prescribed by the National Dam Inspection Act, Public Law 92-367. The technical investigation includes visual inspection, review of available design and construction records, and preliminary structural and hydraulic and hydrologic calculations, as applicable. An assessment of the dam's general condition is included in the report.

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DEPARTMENT OF THE ARMY
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IN REPLY REFER TO
NAPEN-N

(6) National Dam Safety Program, Lake Stockwell Dam (NJ00422), Delaware River Basin, Tributary to Hogans Creek, Burlington County, New Jersey. Phase I Inspection Report.

(11) Feb 80

Honorable Brendan T. Byrne
Governor of New Jersey
Trenton, New Jersey 08621

(12) 651

04 AUG 1980

(9) Final rpts, (10) Rudolph/Wrubel

Dear Governor Byrne:

(15) DACW61-77-C-0012

Inclosed is the Phase I Inspection Report for Lake Stockwell Dam in Burlington County, New Jersey which has been prepared under authorization of the Dam Inspection Act, Public Law 92-367. A brief assessment of the dam's condition is given in the front of the report.

Based on visual inspection, available records, calculations and past operational performance, Lake Stockwell Dam, initially listed as a high hazard potential structure, but reduced to a significant hazard potential structure as a result of this inspection, is judged to be in fair overall condition. The dam's spillway is considered inadequate because a flow equivalent to 11 percent of the One Hundred Year Flood would cause the dam to be overtopped. To ensure adequacy of the structure, the following actions as a minimum, are recommended:

a. The spillway's adequacy should be determined by a qualified professional consultant engaged by the owner using more sophisticated methods, procedures, and studies within six months from the date of approval of this report. Within three months of the consultant's findings, remedial measures to ensure spillway adequacy should be initiated.

b. Within six months from the date of approval of this report, the following remedial actions should be completed:

(1) The eroded downstream slope of the dam embankment at the spillway should be regraded, compacted, and topped with suitable slope paving.

(2) The timber spillway should be inspected and repaired as required.

(3) Remove all dead trees from the embankment.

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NAPEN-N
Honorable Brendan T. Byrne

(4) Further engineering studies should be conducted to investigate the seepage near the abutments.

c. The owners should develop written operating procedures and a periodic maintenance plan to ensure the safety of the dam within one year from the date of approval of this report.

d. The owners should develop an emergency action plan and downstream warning system within six months from the date of approval of this report.

A copy of the report is being furnished to Mr. Dirk C. Hofman, New Jersey Department of Environmental Protection, the designated State Office contact for this program. Within five days of the date of this letter, a copy will also be sent to Congressman Forsythe of the Sixth District. Under the provision of the Freedom of Information Act, the inspection report will be subject to release by this office, upon request, five days after the date of this letter.

Additional copies of this report may be obtained from the National Technical Information Services (NTIS), Springfield, Virginia 22161 at a reasonable cost. Please allow four to six weeks from the date of this letter for NTIS to have copies of the report available.

An important aspect of the Dam Safety Inspection will be the implementation of the recommendations made as a result of the inspection. We accordingly request that we be advised of proposed actions taken by the State to implement our recommendations.

Sincerely,

James G. Ton

1 Incl
As stated

JAMES G. TON
Colonel, Corps of Engineers
District Engineer

Copies furnished:
Mr. Dirk C. Hofman, P.E., Deputy Director
Division of Water Resources
N.J. Dept. of Environmental Protection
P.O. Box CN029
Trenton, NJ 08625

Mr. John O'Dowd, Acting Chief
Bureau of Flood Plain Regulation
Division of Water Resources
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P.O. Box CN029
Trenton, NJ 08625

LAKE STOCKWELL DAM (NJ00422)

CORPS OF ENGINEERS ASSESSMENT OF GENERAL CONDITIONS

This dam was inspected on 12 November 1979 by Louis Berger and Associates, Inc., under contract to the State of New Jersey. The State, under agreement with the U.S. Army Engineer District, Philadelphia, had this inspection performed in accordance with the National Dam Inspection Act, Public Law 92-367.

Lake Stockwell Dam, initially listed as a high hazard potential structure, but reduced to a significant hazard potential structure as a result of this inspection, is judged to be in fair overall condition. The dam's spillway is considered inadequate because a flow equivalent to 11 percent of the One Hundred Year Flood would cause the dam to be overtopped. To ensure adequacy of the structure, the following actions as a minimum, are recommended:

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b. Within six months from the date of approval of this report, the following remedial actions should be completed:

(1) The eroded downstream slope of the dam embankment at the spillway should be regraded, compacted, and topped with suitable slope paving.

(2) The timber spillway should be inspected and repaired as required.

(3) Remove all dead trees from the embankment.

(4) Further engineering studies should be conducted to investigate the seepage near the abutments.

c. The owners should develop written operating procedures and a periodic maintenance plan to ensure the safety of the dam within one year from the date of approval of this report.

d. The owners should develop an emergency action plan and downstream warning system within six months from the date of approval of this report.

APPROVED: James G. Ton

JAMES G. TON
Colonel, Corps of Engineers
District Engineer

DATE: 22 Jul 1980

PHASE I REPORT
NATIONAL DAM INSPECTION PROGRAM

Name of Dam: Lake Stockwell Dam Fed ID# NJ 00422 and NJ ID# 423

State Located New Jersey
County Located Burlington
Coordinates Lat. 3950.8 - Long. 7447.0
Stream Unnamed Tributary of Haynes Creek
Date of Inspection 12 November 1979

ASSESSMENT OF GENERAL CONDITIONS

Lake Stockwell dam is assessed to be in a fair overall condition. It is recommended that the hazard classification be downgraded to significant as overtopping or collapse would cause only minimal downstream property damage. Remedial actions to be undertaken in the future are 1) regrade and protect with slope paving the downstream embankment at spillway, 2) conduct additional inspection, 3) remove dead trees and root systems and make necessary repairs to the spillway. Further engineering studies should also be conducted to investigate the seepage near the abutments.

The spillway capacity of the dam can accommodate only 10% of the design flood and additional hydraulic studies are recommended in view of the hazard classification.

Rudolph Wrubel P.E.
Vice President
Louis Berger & Associates, Inc.

OVERVIEW OF LAKE STOCKWELL DAM

December, 1979

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PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D.C. 20314. The purpose of Phase I investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation, and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through continued care and inspection can there be any chance that unsafe conditions be detected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the Spillway Test flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. The test flood provides a measure of relative spillway capacity and serves as an aid in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM
NAME OF DAM: LAKE STOCKWELL DAM FED ID# NJ 00422

SECTION 1 - PROJECT INFORMATION

1.1 GENERAL

a. Authority

This report is authorized by the Dam Inspection Act, Public Law 92-367, and has been prepared in accordance with Contract FPM-36 between Louis Berger & Associates, Inc. and the State of New Jersey and its Department of Environmental Protection, Divison of Water Resources. The State, in turn, is under agreement with the U.S. Army Engineer District, Philadelphia, to have this inspection performed.

b. Purpose of Inspection

The purpose of this inspection is to evaluate the structural and hydraulic condition of the Lake Stockwell Dam and appurtenant structures and to determine if the dam constitutes a hazard to human life or property.

1.2 DESCRIPTION OF PROJECT

a. Description of Dam and Appurtenances

Lake Stockwell Dam is an earth embankment approximately 260 feet long, some 200 feet of which forms the embankment of an unpaved roadway to Y.M.C.A. Camp Ockanickon. The crest along the road is 20 feet wide, maximum height is 12 feet, and slopes are steep (approximately 1:1) and brush covered. The lake is a recreation facility for the summer camp in a heavily wooded setting. A timber box or standpipe spillway structure occupies a central location of the embankment, and contains manually removable flashboards. The spillway represents at least the second similar structure at the site over a 45 year span. A relatively low area near the left abutment is designated an auxiliary spillway which discharges in a dispersed fashion through woodland.

b. Location

Lake Stockwell Dam is located within the Y.M.C.A. Camp Ockanickon boundaries near the Borough of Medford Lakes, Burlington County, New Jersey. The dam is approximately 3.2 miles southwest of the intersection of Route 70 and Route 206 and is built across the Sharps Branch of Haynes Creek and is immediately upstream of Upper Aetna Lake.

c. Size Classification

The Lake Stockwell Dam has a maximum height of 12 feet and a maximum storage capacity of 176 acre-feet. Accordingly, this dam is in the small size category as defined by the criteria in the Recommended Guidelines for Safety Inspection of Dams (maximum storage less than 1,000 acre-feet and height less than 40 feet).

d. Hazard Classification

Based on the Corps of Engineers criteria and the fact that in the event of a failure moderate damage could be inflicted on downstream property with a modest potential for loss of life, the dam is classified as a significant hazard. Upper Aetna Lake is almost immediately downstream and is solidly ringed with homes only a few feet above normal flood elevation. A failure at Lake Stockwell could conceivably cause a breach in Upper Aetna Lake Dam, discharging both lakes into Lower Aetna Lake (which is similarly intensively developed at marginal elevations). If both of these downstream dams failed under the triggering effect of a Lake Stockwell Dam failure, additional damage could also be inflicted on property still further downstream, unlike that envisioned from the failure limited to one or both of the lower dams without further contribution from the upstream pool. Additionally, there are still other lakes upstream of Lake Stockwell and a collapse of two or more of these could also impose extreme stresses on the study dam. Further, all downstream dams are similarily classified as significant hazard.

e. Ownership

The dam is owned and operated by Y.M.C.A. Camp Ockanickon, Inc., Medford, New Jersey 08055.

Their office is located on an unnamed access road just to the north of the study dam.

f. Purpose of Dam

The lake impounded by the dam is used solely for recreational purposes.

g. Design and Construction History

The first dam and lake for recreational camp use was reportedly built in 1926, making use of an existing structure that originally provided power for a sawmill. In 1934, installation of embankment and spillway in its approximate present form followed plans by the State of New Jersey Civil Works Administration Project No. 2195, dated April, 1934. State Water Policy Commission records contain an application by Camp Ockanickon for its repair or reconstruction dated July 26, 1947, accompanied by a drawing by Arthur C. Ladow entitled "Flood Gate and Dam, Camp Ockanickon, Medford, New Jersey". This work reportedly repaired flood damage to the dam and work was presumably accomplished shortly after approval of the application in October of the same year. There are no later records.

h. Normal Operating Procedures

Operation and maintenance of the dam and lake is carried out by the Y.M.C.A. groundskeeping staff as part of their overall duties. Regulation of the water level requires manual adjustment and coordination with both upstream and downstream owners (see Section 4).

1.3 PERTINENT DATA

a. Drainage Area

The overall drainage area for Lake Stockwell dam is 5.05 square miles which includes 1.55 square miles impounded by the Upper Stokes Dam.

b. Discharge at Dam Site

The spillway discharge capacity with the reservoir at crest elevation is calculated to be approximately 515 cfs. No discharge records are available.

c. Elevation (Above M.S.L.)

Top of dam - +75
Recreation pool - +72 (spillway crest)
Normal backwater - +68 (lower lake)
Streambed at center line of dam - +63.2±

d. Reservoir

Length of recreation pool - 3200 feet
Length of maximum pool - 3700 feet

e. Storage

Recreation pool - 61 acre-feet
Top of dam - 176 acre-feet

f. Reservoir Surface

Recreation pool - 23 acres
Top of dam - 53 acres

g. Dam

Type - Earth embankment with timber drop box inlet spillway
Length - 260 feet
Height - 12 feet
Freeboard between normal reservoir and top of dam - 3 feet
Top width - 20 feet
Side slopes - Varies (1H:1V)
Zoning - Composition and compactness unknown

h. Diversion and Regulating Tunnel

None

i. Spillway

Type - Timber weir drop inlet
Length of weir - 16' (overall)
Effective length - 14.9'

j. Regulating Outlets

None

SECTION 2 - ENGINEERING DATA

2.1 DESIGN

The only information available for design review were original blueprints of the 1934 spillway plan and microfilm copies of the subsequent construction dated 1947. The spillway is founded on timber piles and protected from undercutting by wood T&G sheeting on all sides. Further search of the records of the State Division of Water Resources revealed nothing on file of a technical nature. Regarding the geotechnical aspects, the dam is situated along an undulating interstream divide covered with recent silt and sand alluvium with some clay and a significant amount of organic matter near the surface. Its depth is indicated as usually in excess of ten feet. Underlying the alluvium, and existing as surficial soil beyond the stream divide is the Kirkwood Sand formation. This soil is a fine micaceous quartz sand with interbedded silty sand layers. Depth to bedrock is greater than 100 feet.

2.2 CONSTRUCTION

Little information was obtained regarding the actual construction as no as-built plans were available. From the record and verbal accounts, no significant modifications have been made since the 1947 reconstruction.

2.3 OPERATION

See Section 4.

2.4 EVALUATION

a. Availability

In view of the dam assessment and recommendations contained in Section 7, it is believed that sufficient engineering data is available for the following assessment.

b. Adequacy

In view of the dam assessment and recommendations contained in Section 7, it is felt the field inspection provided adequate engineering data upon which to base a reliable assessment.

c. Validity

The validity of the 1934 and 1947 plans is not challenged and is accepted without recourse to further investigations.

SECTION 3 - VISUAL INSPECTION

3.1 FINDINGS

a. General

The visual inspection was conducted on 12 November, 1979, at which time the water level of the lake was near its normal elevation, producing a moderate flow over the spillway weir. Both the relatively narrow configuration of the spillway box and the flow, as well as the fairly high water level, prevented close inspection of the spillway walls. The outlet was entirely inaccessible, being submerged (even below the low water of the downstream pool at the time of inspection).

b. Dam

The roadway embankment, which forms the greater part of the dam, was assessed to be in a solid and stable condition although both upstream and downstream slopes are heavily wooded and irregular. Slopes vary from a nominal 1H:1V of the reconstruction plan to the much steeper ones indicated on the original 1934 print. The crest is the main access road to the camp, and is in fairly good condition although unpaved. The horizontal alignment seems even including abutments, and the sandy surface is slightly lower than the brush covered shoulders. Numerous small trees (4" to 10" diameter) are scattered through the heavy brush on both slopes. The narrower and lower (12' x 1-1/2') embankment that continues to the left abutment along the heavily wooded shoreline includes the rough-graded auxiliary spillway zone. Some seepage is evident in the forested area below this part of the embankment even in the roadway, and appears to be a chronic problem. Major erosion problems were also noted on the downstream slope at the spillway, where large gullies have apparently been recently filled. This erosion could be a function of the lack of vegetation on this steep slope of cohesionless soil, and be prevented from becoming even worse by the tendency of runoff to follow the well defined roadway depression. No riprap is evident at this or other points along the embankment slopes.

c. Appurtenant Structures

The spillway is located near the center of the roadway portion of the embankment. Its intake is a narrow, vertical timber box, 8 feet by 2-1/2 feet, that rises from the toe of the embankment slope and stands apart from the exposed upper slope. The broad side (facing the lake) serves as the adjustable spillway with removable flashboards but its length is effectively doubled with high water when the fixed, but open back face also overflows. Water overflowing through this vertical structure is carried in a horizontal sluiceway continuation of the same construction and dimensions. It crosses at the base of the embankment at right angles to discharge into the downstream channel or pool and appears to lie well below the surface of the normal tailwater elevation of the lower lake. The entire structure is supported on a timber frame mudsill which in turn rests on vertical timber bearing piles that penetrate into the underlying sand. Upstream, center, and downstream tongue and groove cutoff walls complete the spillway structure. A major difficulty of the inspection was that very little of the spillway could be examined regarding its condition. The auxiliary spillway, as previously noted, is simply an overflow zone near the left abutment. An attempt to minimize damage to the road in the seepage area of this zone is the installation of a 10 inch diameter cross drain.

d. Reservoir

Lake Stockwell has a stable shoreline, and gentle slopes covered with trees and brush. The water was clear at the time it was inspected, and there was no indication of any accumulation of debris. The status of the lake bottom and possible silting near the spillway is not known. A number of dams lie further upstream, from the one at Squaw Lake and other smaller ones on the main stream to Upper Stokes and a series of others on a large tributary.

e. Downstream Channel

Lake Stockwell drains directly into Papoose Lake, a smaller pool between it and the Upper Aetna reservoir. At the time of inspection, this lake was quite low but still covered the spillway

outlet. At normal levels it is fairly shallow and of limited capacity within its heavily wooded shoreline. Some large riprap in the form of chunks of broken concrete effectively resist scour at the point of discharge from Lake Stockwell. Head differential as measured was 5.5 feet. There are few houses on the shores of Papoose Lake, but many along the banks of Upper and Lower Aetna Lakes. Davy Crockett Dam, which impounds Papoose Lake, reportedly was overtopped and breached some 7 years ago.

SECTION 4 - OPERATIONAL PROCEDURES

4.1 PROCEDURES

Operational procedures were not observed in action by the inspection team, but were discussed at some length with the owner's representative responsible for them. Control of the lake level is exercised as necessary for effects of storms, or for maintenance or repairs. Occasional large scale effort, such as periodic clearing of debris, is performed with temporary work crews, and normal operations by one or more full time personnel.

4.2 MAINTENANCE OF DAM

Little major maintenance has been carried out at the dam recently except for the removal of debris and dead timber along the ustream slopes. The crest roadway is fairly well maintained and erosion gullies at the spillway outlet were filled. The roadway has been recently regraded by a motorized road grader and is in fair condition.

4.3 MAINTENANCE OF OPERATING FACILITIES

No apparent recent maintenance was evident, but repair or clearing of the spillway was reported to be performed as it becomes necessary.

4.4 DESCRIPTION OF ANY WARNING SYSTEM IN EFFECT

An informal system of communication exists among individuals responsible for some of the larger lakes of the chain of ten or more dams within this tributary. It apparently fun .ons well enough between Stockwell and the two Aetna kes downstream, and with the owner of the Squaw Lake m immediately upstream.

4.5 EVALUATION

Present procedures indicate that the dam is closely monitored by the Y.M.C.A. Chief of Maintenance as part of his overall responsibilities. He, along with his staff, conduct a well-managed operation and is fully aware of what is needed. A more formal warning system should exist, to alert local Civil Defense and downstream municipal authorities of any danger due to

abnormal conditions and there should be some resolution of the lack of information from upstream. In addition, itemized inspection by the State Division of Water Resources is not done on an annual basis permitting gradual deterioration of this and other dams. The last recorded inspection obtained took place nine years ago (see Section 7).

SECTION 5 - HYDRAULIC/HYDROLOGIC

5.1 EVALUATION OF FEATURES

a. Design Data

In accordance with the criteria in the Recommended Guidelines for Safety Inspection of Dams, it has been determined that Lake Stockwell Dam is small in size and of significant hazard. Accordingly, a 100-year frequency event was selected as the design storm. An inflow hydrograph for the drainage area of Lake Stockwell below Upper Stokes Dam, was calculated using precipitation data from Technical Paper 40 and NOAA Technical Memorandum NWS Hydro-35. The routed outflow from Upper Stokes Dam was added to the Lake Stockwell inflow, since Upper Stokes Dam lies immediately upstream and within the overall drainage basin of Lake Stockwell. The total inflow was then routed through Lake Stockwell.

The inflow to the lake for the selected 100-year storm was computed utilizing the HEC-1 computer program. The calculated peak flow to Lake Stockwell was 6862 cfs, and routing reduced the peak to 5378 cfs. The maximum spillway discharge capacity before overtopping the dam is approximately 515 cfs. Thus, the spillway can accommodate only 10% of the design flood, and is therefore considered inadequate.

b. Experience Data

There are no stream flow records available for Rancocas Branch contributing to Lake Stockwell. The most recent repair application, No. 423 (31-91), dated July 26, 1947, indicated a spillway capacity of 145 cfs and an estimated flood flow of 56 cfs per square mile drainage area. This indicates that the design flood flow could have been derived from the New Jersey Flood Runoff Index Curves, Low South Jersey Curve for a frequency period of 5 years, which has been estimated to be 82% of the 15 year value.

c. Visual Observation

The spillway appears to function satisfactorily at normal and low flows. At high flows the roadway embankment above the spillway is apparently easily overtopped. In addition to overtopping at the dam and spillway structure it was also observed that road overtopping must occur at a lower point in the roadway, away from the vicinity of the dam, this point acting as an auxiliary spillway.

d. Overtopping Potential

Since the spillway structure has a very limited capacity, the 100-year frequency flood computed in the hydrologic analysis herein will produce a theoretical water surface elevation of 3.4' above the dam crest.

e. Drawdown

The lake can be dewatered down to the stream bed elevation of +63.2 in approximately 10 hours. This can be accomplished by removing the flashboards on the outflow structure. The flow will then be controlled by the culvert portion of the structure, at a steady rate determined by an assumed steady differential head of 4' between the lake elevation and the downstream water surface elevation.

SECTION 6 - STRUCTURAL STABILITY

6.1 EVALUATION OF STRUCTURAL STABILITY

a. Visual Observations

The roadway embankment appears stable in spite of the steep, irregular slopes, due primarily to the thick cover of trees and brush. The eroded, open slope area above the spillway outlet shows severe previous scouring and could be subject to more serious effects leading to a complete breach if the dam should be overtopped. The heavily wooded embankment is very stable and because a part functions as an auxiliary spillway, this helps to reduce the possibility of the entire roadway being overtopped. However, the downstream wooded area below it exhibits persistent seepage. The cross sectional dimensions of the embankment are believed to provide an adequate safety factor regarding stability. The overall alignment and condition of the spillway structure is fairly good and it appears to be performing adequately, but a more thorough examination is needed, which can only be done by dewatering both lakes. A few rotted pieces at the exposed top of the drop inlet should be replaced. Little is known about the condition of the upstream channel or lake bed, but the downstream channel seems satisfactory and reasonably well protected.

b. Design and Construction Data

The two engineering drawings, dated 1934 and 1947, furnish sufficient data to evaluate the spillway structure although no details are available on its actual original construction or repair. Although nothing is known about the embankment beyond the indication of a central sand core on the earlier plan, it appears to be well-compacted and in adequate condition except for the exposed areas on the downstream slope. Further observations would be required to verify the source and extent of observed seepage.

c. Operating Records

No formal operating records exist and the dam has apparently been inspected only once within the last ten years. It appears to have operated

satisfactorily since its 1947 modification, but may have experienced severe damage just prior to both instances of construction activity on the present spillway. The smaller dam below this one was reportedly overtopped and breached about 7 years ago.

d. Post Construction Changes

No changes have been made since the 1947 reconstruction.

e. Seismic Stability

The dam appears to have an adequate factor of safety against static loadings and experience indicates that it will therefore have adequate stability against Seismic Zone 1 dynamic loadings. The maximum embankment height is so little that it will have negligible vulnerability due to earthquake loadings.

SECTION 7 - ASSESSMENTS/RECOMMENDATIONS/ REMEDIAL MEASURES

7.1 DAM ASSESSMENT

a. Safety

Subject to the inherent limitations of the Phase I visual inspection, Lake Stockwell Dam is classified as being in a sound and overall fair condition. Except for observed seepage and localized downstream erosion, no seriously detrimental findings were revealed in this inspection to render a questionable judgement as to structural stability. Overtopping of the roadway at the main spillway location could seriously damage or breach the embankment, but the potential for this is countered to some extent by effectiveness of the auxiliary spillway. It was impossible to examine the existing spillway structure with any degree of thoroughness due to its particular configuration and fairly high water level at the time of inspection. No significant increase in spillway capacity could be invisioned short of major construction. However, in summary, the dam is adjudged to be in a fair overall condition.

b. Adequacy of Information

The information gathered for the Phase I inspection is deemed to be adequate for a realistic assessment despite a lack of detail regarding actual construction. No surveys or inspections have been recorded since 1970 and the dam has undergone some deterioration since that time.

c. Urgency

Further investigation is recommended to be undertaken in the future to add precision to knowledge about the dam and its potential behavior. Any abrupt failure of this dam could cause damage to one or more downstream dams, and could threaten several homes and possibly some lives. However, in view of the operating record for several decades, it is recommended this be undertaken in the future.

d. Necessity for Further Study

The present structural condition of the existing spillway structure must be further determined with greater thoroughness and accuracy, which will require examination during periods of lower water levels both up and downstream. Condition of the lake bed near the dam and of the down-stream channel can be observed at the same time as well as the seepage near the abutments. Adequacy of the spillway structure and the auxiliary spillway zone should be evaluated for various cases that take into account the probable effects of upstream dam failures.

7.2 RECOMMENDATIONS/REMEDIAL MEASURES

It is recommended that further engineering studies be initiated in the near future as the dam is classified in the significant hazard category and its spillway hydraulic capacity is inadequate.

a. Recommendations

- The downstream slope of the dam embankment at the spillway should be regraded, compacted, and topped with suitable slope paving.
- Necessary repairs should be made to the timber spillway as dictated by subsequent inspections.
- Remove all dead trees and root systems.

b. O&M Maintenance and Procedures

In the near future the owner should develop written operating procedures and a periodic maintenance plan to insure the safety of the dam. Additionally, a more formal warning system should be established with all the lake owners along this tributary.

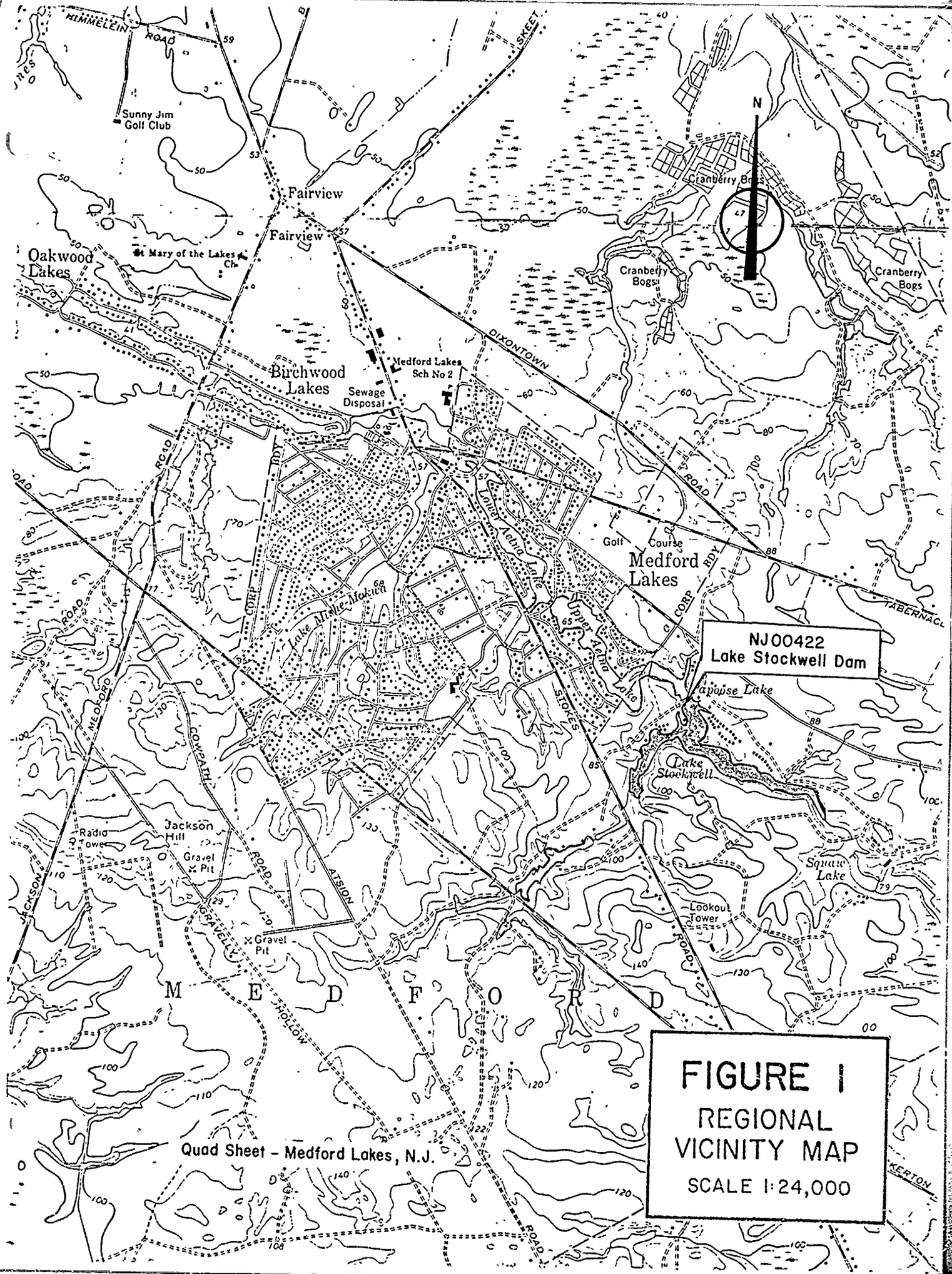
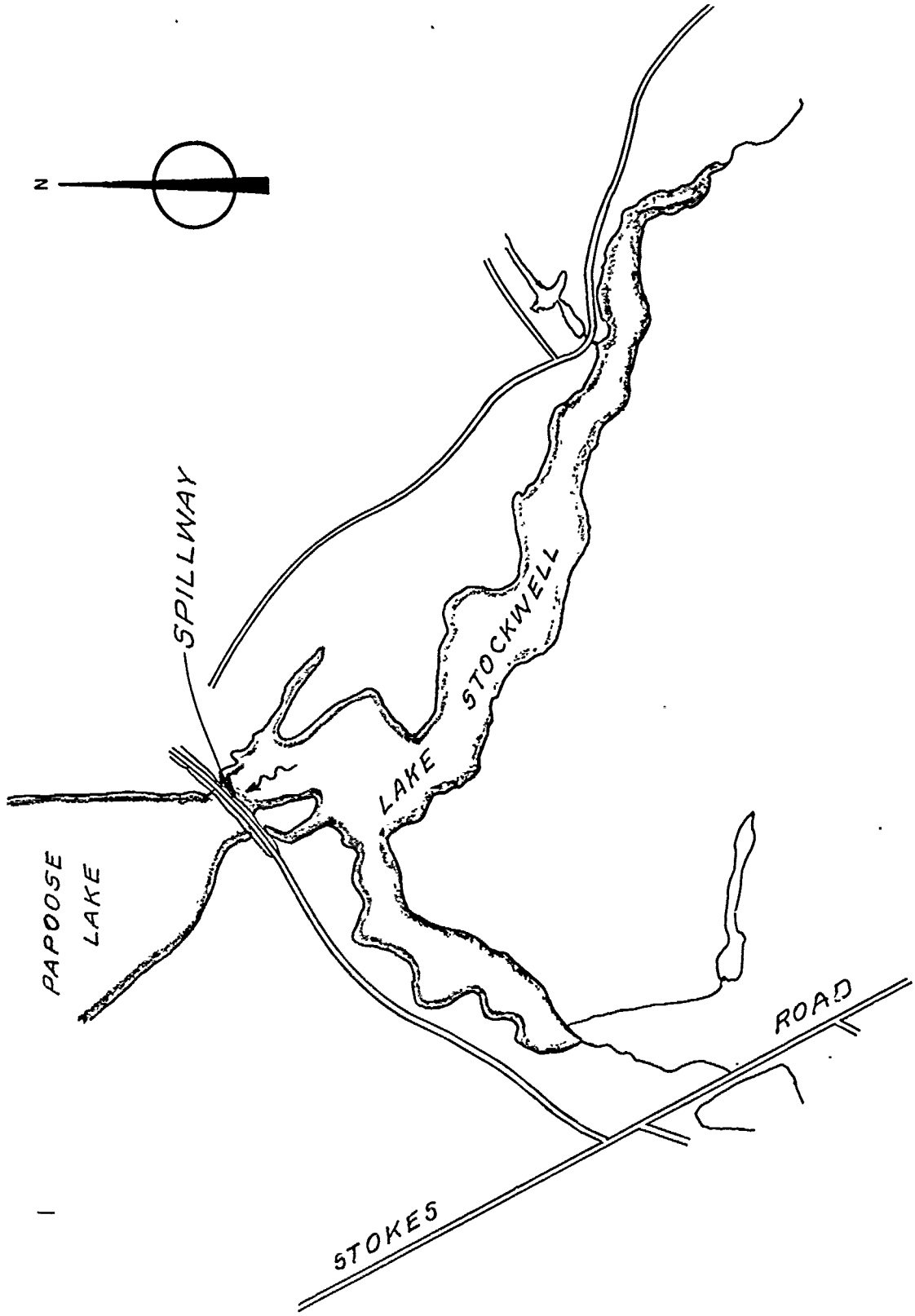


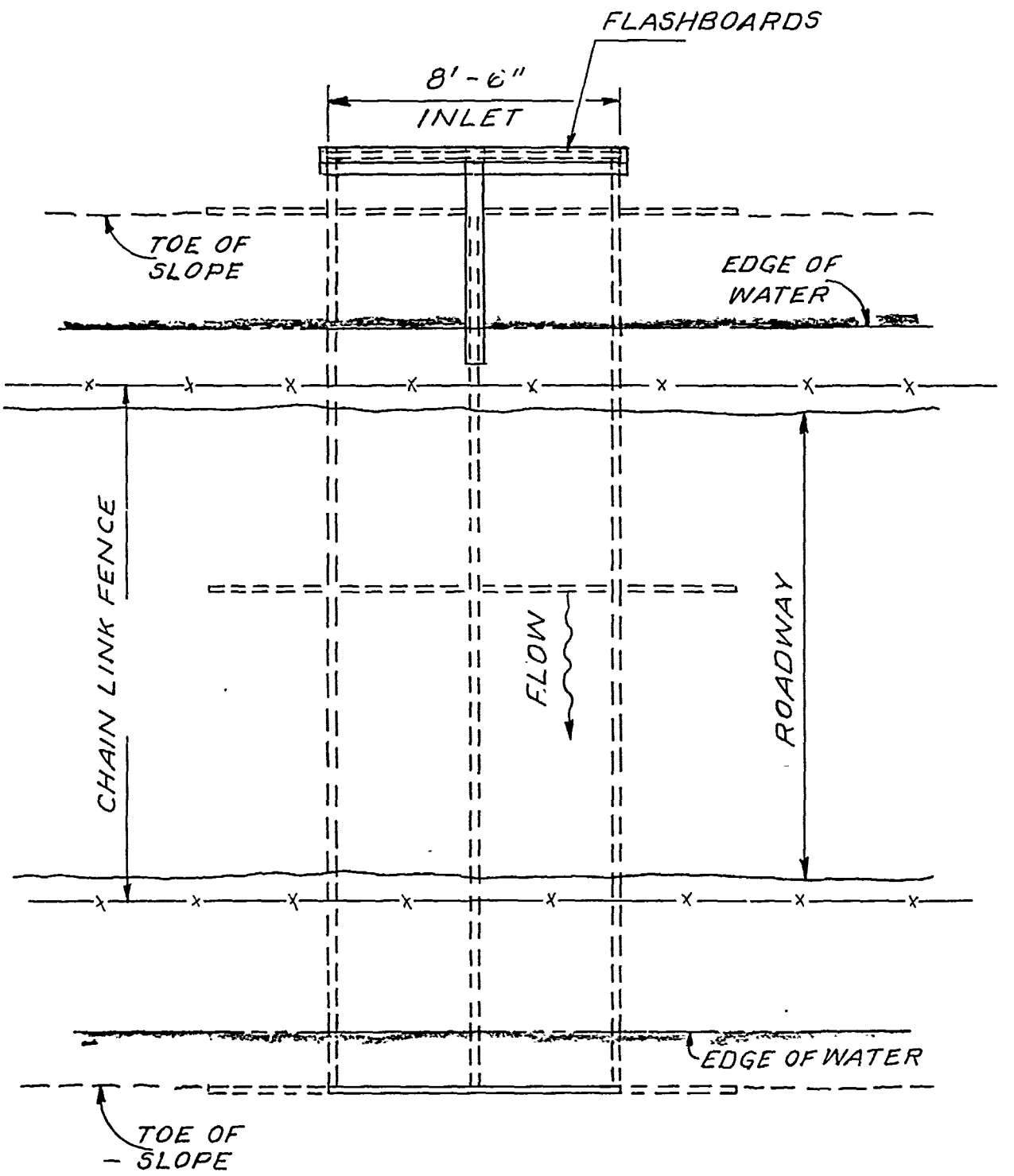
FIGURE 1
REGIONAL VICINITY MAP
SCALE 1:24,000



LOCATION PLAN

FIGURE 2

LAKE STOCKWELL

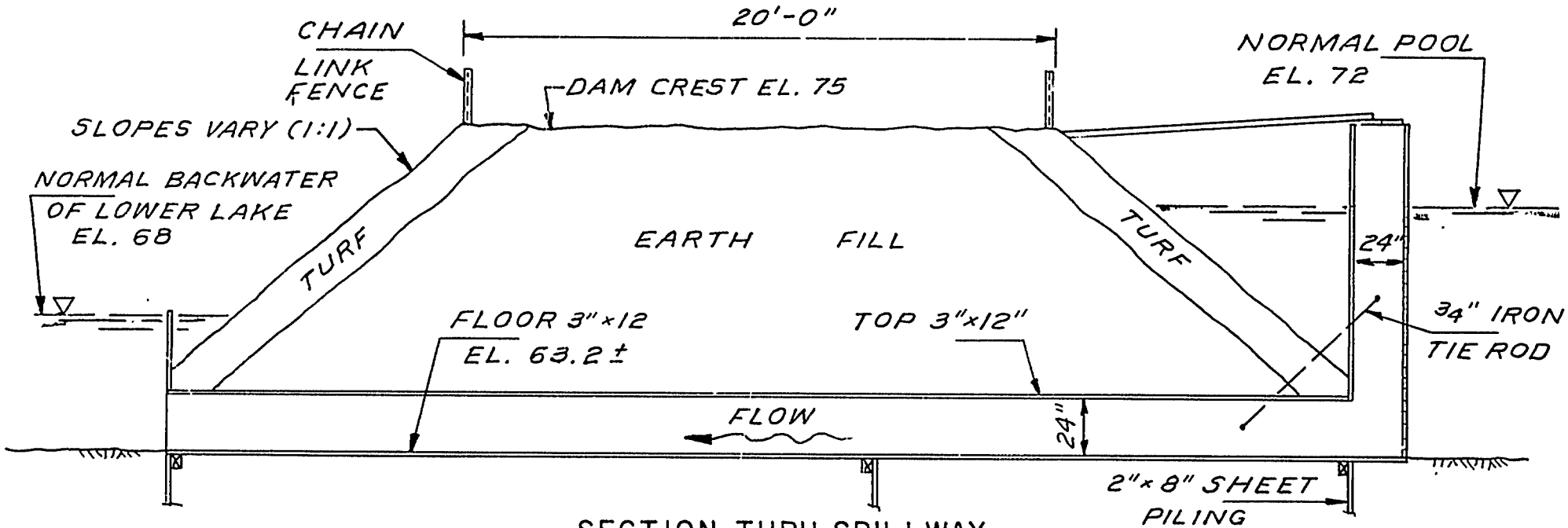


PLAN

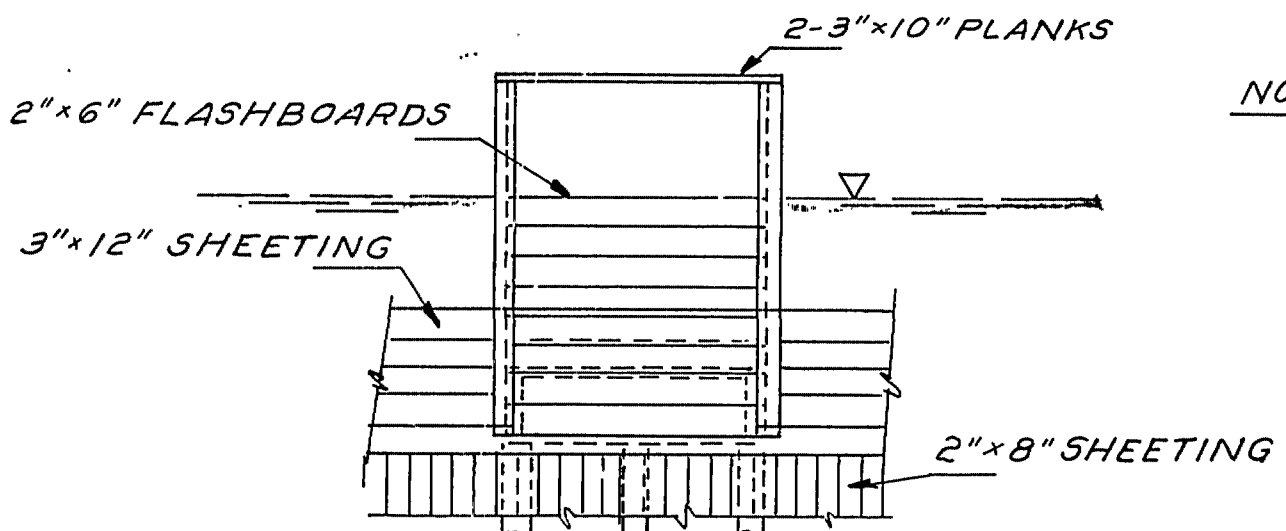
NOT TO SCALE

SPILLWAY

FIGURE 3



SECTION THRU SPILLWAY



NOT TO SCALE

INLET ELEVATION

FIGURE 4 SPILLWAY DETAILS

Check List
Visual Inspection
Phase 1

Name Dam Lake Stockwell County Burlington State New Jersey Coordinators NJDEP

Date(s) Inspection 11/12/79 12/27/79 Weather Overcast Temperature 50°F

Pool Elevation at Time of Inspection 72 M.S.L. Tailwater at Time of Inspection 66.5 M.S.L.

Inspection Personnel:

D. Lang
Rick Hiles (owner's rep.)
J. Voorhees
K. Jolls
L. Baines

D. Lang Recorder

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS	None evident.	
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE	None evident.	
SLOUGHING OR EROSION OF EMBANKMENT AND ABUTMENT SLOPES	Both u/s and d/s embankments heavily covered with brush and small to intermediate (4 - 10" Ø) pine trees. Slopes fairly steep, greater than 1:1 in most places. Some erosion above outlet due to surface runoff. Depressed roadway helps control erosion from surface runoff.	
VERTICAL AND HORIZONTAL ALINEMENT OF THE CREST	Top width approx. 18'. 5½' head differential between two lakes. Horizontal and vertical alignment fair, low spot in embankment near left abutment.	
RIPRAP FAILURES	No riprap evident.	

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
JUNCTION OF EMBANKMENT AND ABUTMENT, SPILLWAY AND DAM	Good	
ANY NOTICEABLE SEEPAGE	Possible seepage evident at low spot at left abutment (Auxiliary spillway).	
STAFF GAGE AND RECORDER	None	
DRAINS	None	

OUTLET WORKS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CRACKING AND SPALLING OF CONCRETE SURFACES IN OUTLET CONDUIT	N.A.	
INTAKE STRUCTURE	See ungated spillway	
OUTLET STRUCTURE	Submerged timber box.	Close inspection impossible.
OUTLET CHANNEL	Papoose Lake	
EMERGENCY GATE	None	

UNGATED SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE WEIR	Timber weir 96" wide. 42" high from top of flashboards to top cross planks. Timber in fairly good condition. Top cross planks need replacement.	Flashboards are removed by hand.
APPROACH CHANNEL	Lake Stockwell - open and clear of debris.	Swimming area.
DISCHARGE CHANNEL	Low lying swamp area, wide and fairly clear (Papoose Lake).	
BRIDGE AND PIERS	None	

RESERVOIR

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SLOPES	Mild slopes, heavily wooded with scrub pine and underbrush. Bathing area on north side of lake.	
SEDIMENTATION	Unknown	

DOWNSTREAM CHANNEL

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONDITION (OBSTRUCTIONS, DEBRIS, ETC.)	None, low lying swampy area (drained Davey Crockett Lake).	
SLOPES	Gentle, large flood plain.	
APPROXIMATE NO. OF HOMES AND POPULATION	None immediately below Stockwell dam, houses are below Davey Crockett Dam on Papoose Lake.	

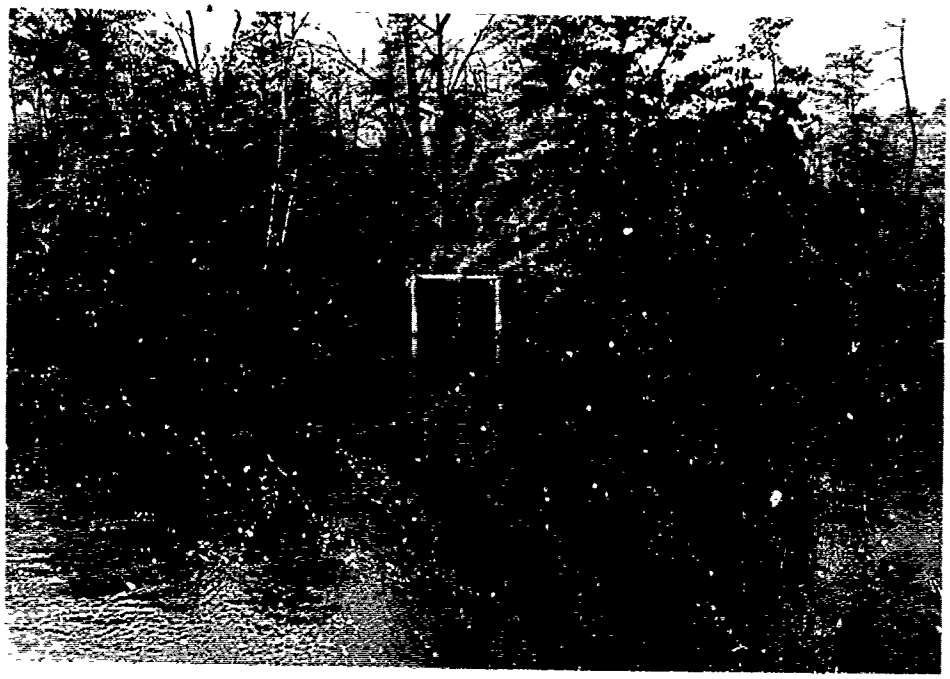
CHECK LIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION

ITEM	REMARKS
PLAN OF DAM	Not available
REGIONAL VICINITY MAP	Available - USGS Quad - Medford Lakes, N.J.
CONSTRUCTION HISTORY	Not available
TYPICAL SECTIONS OF DAM	Not available
HYDROLOGIC/HYDRAULIC DATA	Not available
OUTLETS - PLAN	1947 Construction Plans - NJDEP - Division of Water Resources - Bureau of Flood Plain Management - Trenton, N.J.
- DETAILS	Not available
-CONSTRAINTS	Not available
-DISCHARGE RATINGS	Not available
RAINFALL/RESERVOIR RECORDS	Not available

ITEM	REMARKS
SPILLWAY PLAN	1947 Construction Plan - NJDEP
SECTIONS	" " " "
DETAILS	Not available
OPERATING EQUIPMENT PLANS & DETAILS	Not available

ITEM	REMARKS
DESIGN REPORTS	Not available
GEOLOGY REPORTS	Not available
DESIGN COMPUTATIONS	Not available
HYDROLOGY & HYDRAULICS	" "
DAM STABILITY	" "
SEEPAGE STUDIES	" "
MATERIALS INVESTIGATIONS	Not available
BORING RECORDS	" "
LABORATORY	" "
FIELD	" "
POST-CONSTRUCTION SURVEYS OF DAM	Not available
BORROW SOURCES.	Unknown

ITEM	REMARKS
MONITORING SYSTEMS	None
MODIFICATIONS	None known since 1947 Reconstruction
HIGH POOL RECORDS	None
POST CONSTRUCTION ENGINEERING STUDIES AND REPORTS	None available
PRIOR ACCIDENTS OR FAILURE OF DAM DESCRIPTION REPORTS	None known
MAINTENANCE OPERATION RECORDS	None available



November, 1979

View of Spillway Inlet

November, 1979

Downstream View of Dam

November, 1979

View of Crest Looking West

November, 1979

View Looking Downstream

CHECK LIST
HYDROLOGIC AND HYDRAULIC DATA
ENGINEERING DATA

DRAINAGE AREA CHARACTERISTICS: 5.05 square miles

ELEVATION TOP NORMAL POOL (STORAGE CAPACITY): 72 MSL (61 acre-feet)

ELEVATION TOP FLOOD CONTROL POOL (STORAGE CAPACITY): 75 MSL (176 acre-feet)

ELEVATION MAXIMUM DESIGN POOL:

ELEVATION TOP DAM: 75 MSL

CREST:

a. Elevation +75 MSL
b. Type Earth embankment with timber drop inlet spillway
c. Width 20 feet
d. Length 260 feet
e. Location Spillover
f. Number and Type of Gates

OUTLET WORKS:

a. Type Timber weir drop inlet
b. Location Center of roadway embankment
c. Entrance inverts 72 MSL
d. Exit inverts 63.2± MSL
e. Emergency draindown facilities Flashboards on front face of spillway

HYDROMETEOROLOGICAL GAGES: None

a. Type
b. Location
c. Records

MAXIMUM NON-DAMAGING DISCHARGE: 515 cfs

BY L.B. DATE 12-79
CHKD. BY J.C. DATE 12-79
SUBJECT

LOUIS BERGER & ASSOCIATES INC.

LAKE STOCKWELL DAM

SHEET NO. A1
PROJECT C-2542

TIME OF CONCENTRATION

CALIFORNIA CULVERTS PRACTICE

Length of Longest watercourse = 12760 ft = 2.4 miles

$\Delta H = 115 - 72 = 43'$

$$t_c = \left(\frac{11.9 L^3}{H}\right)^{0.385} = \left(\frac{11.9 (2.4)^3}{43}\right)^{0.385} = 1.7 \text{ hrs}$$ ✓

ALTERNATE METHOD

Slope along watercourse $= \frac{28' \times 100}{10560} = 0.26\%$

Assume velocity = 2.0 ft-sec^{-1}

$$t = \frac{10560}{2 \text{ ft-sec}^{-1} \times 3600} = 1.47 \text{ hrs}$$

OVERLAND FLOW $\Delta H = 15'$

Slope $= \frac{15 \times 100}{2200} = 0.63\%$

Assume velocity = 1.5 ft-sec^{-1}

$$t' = \frac{2200}{1.5 \times 3600} = 0.41 \text{ hrs}$$

$\therefore t_c = t' + t = 0.41 + 1.47 = 1.88$ hrs

USE $t_c = 1.79$ hrs ✓

$$T_p = \frac{D}{2} + 0.6\, t_c$$

$$= \frac{25}{2} + 0.6(1.79)$$

$= 1.20$ hrs ✓

BY L.B. DATE 12-79
CHKD. BY ____ DATE ____
SUBJECT ____

LOUIS BERGER & ASSOCIATES INC.
LAKE STOCKWELL DAM

SHEET NO. A2 OF ____
PROJECT C-246

D.A = 3.5 S.M.

$$Q_p = \frac{K \times \text{Drainage Area}}{T_p}$$

$$= \frac{484 \times 3.5}{1.20}$$

$$= 1,412 \text{ cfs}$$

UNITGRAPH

TIME (hours)	T/T_p	DIMENSIONLESS ORDINATE	Q (cfs) = $Q_1 \times D_0$
0.25	0.21	0.082	116
0.50	0.42	0.309	436
0.75	0.63	0.649	916
1.00	0.83	0.916	1293
1.25	1.04	0.997	1408
1.50	1.25	0.885	1250
1.75	1.46	0.697	984
2.00	1.67	0.502	709
2.25	1.88	0.378	534
2.50	2.08	0.285	402
2.75	2.29	0.212	299
3.00	2.50	0.153	216
3.25	2.71	0.111	157
3.50	2.92	0.083	117
3.75	3.13	0.062	88
4.00	3.33	0.046	65
4.25	3.54	0.034	48
4.50	3.75	0.0263	37
4.75	3.96	0.019	25
			$\Sigma = 9100$

CHECK $\frac{9100 \text{ ft}^3}{\text{sec}} \times \frac{\text{m}^2}{5280^2 \text{ ft}^2} \times \frac{12 \text{ in}}{1 \text{ ft}} \times \frac{3600 \text{ sec}}{1 \text{ hr}} \times \frac{1 \text{ hr}}{1} = 1.007 \text{ in} \approx 1 \text{ in}$ ✓

BY J.C. DATE 12-79

CHKD. BY DATE

LOUIS BERGER & ASSOCIATES INC.

SHEET NO. A3 OF

PROJECT C246

MEDFORD LAKES DAM INSPECTION

SUBJECT DEPTH - DURATION RAINFALL DATA FROM TP 40 & HMR 36

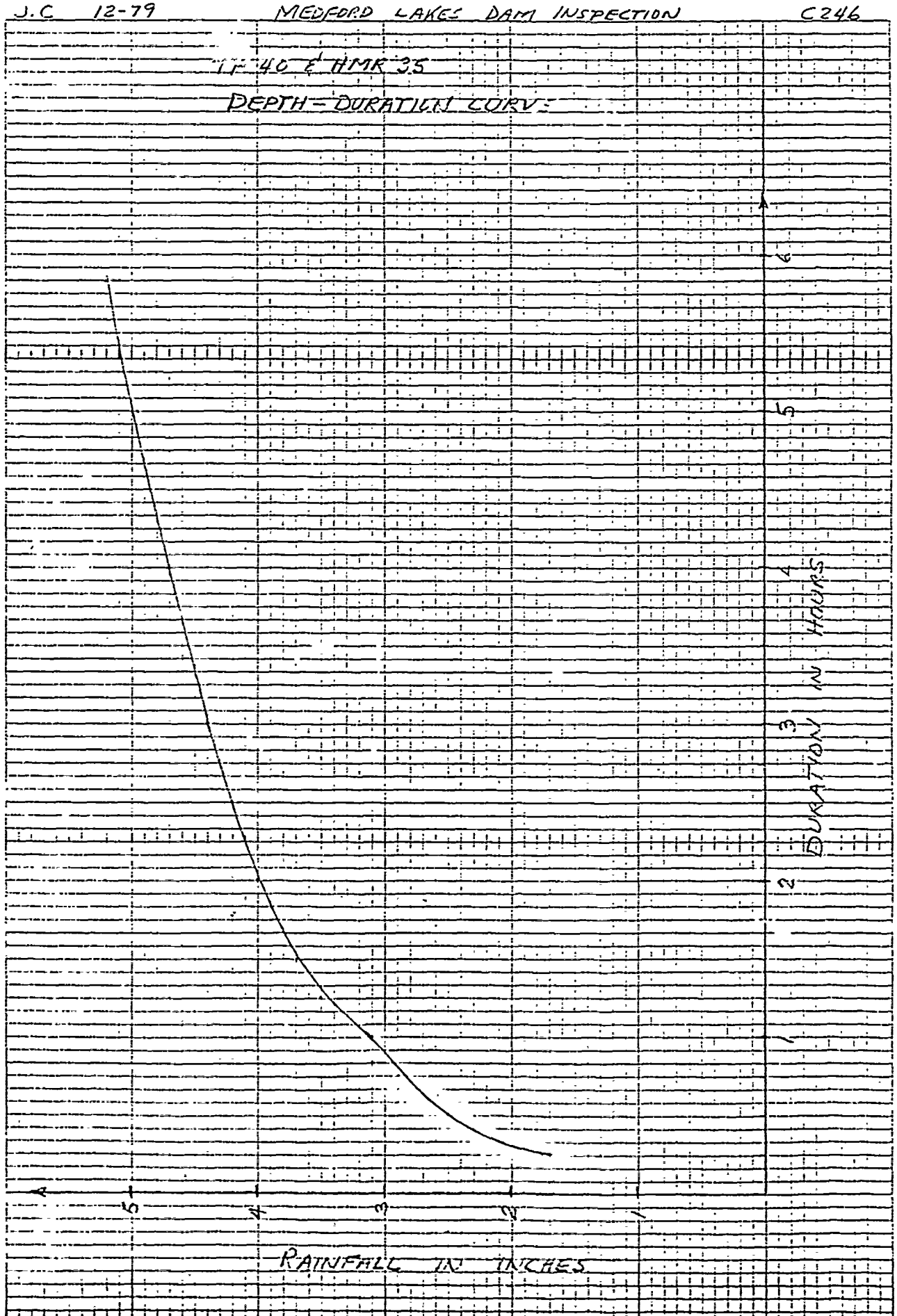
100 YR FREQUENCY

TIME	PRECIPITATION	Δ	REARRANGE
0.25	1.7	1.7	0.06
0.50	2.4	0.7	0.06
0.75	2.8	0.4	0.06
1.00	3.1	0.3	0.06
1.25	3.5	0.4	0.07
1.50	3.7	0.2	0.07
1.75	3.86	0.16	0.08
2.00	4.00	0.14	0.09
2.25	4.11	0.11	0.09
2.50	4.22	0.11	0.09
2.75	4.31	0.09	0.11
3.00	4.40	0.09	0.11
3.25	4.49	0.09	0.30
3.50	4.57	0.03	0.70
3.75	4.64	0.07	1.70
4.00	4.71	0.07	0.40
4.25	4.78	0.07	0.40
4.50	4.84	0.06	0.20
4.75	4.90	0.06	0.16
5.00	4.96	0.06	0.14
5.25	5.02	0.06	0.07
5.50	5.08	0.06	0.06
5.75	5.14	0.06	0.06
6.00	5.20	0.06	0.06

J.C 12-79 MEDFORD LAKES DAM INSPECTION C246

TP 40 & HMR 35

DEPTH - DURATION CURVE



BY. J. Cerniglia DATE 12/79

CHKD. BY. _____ DATE _____

SUBJECT _____

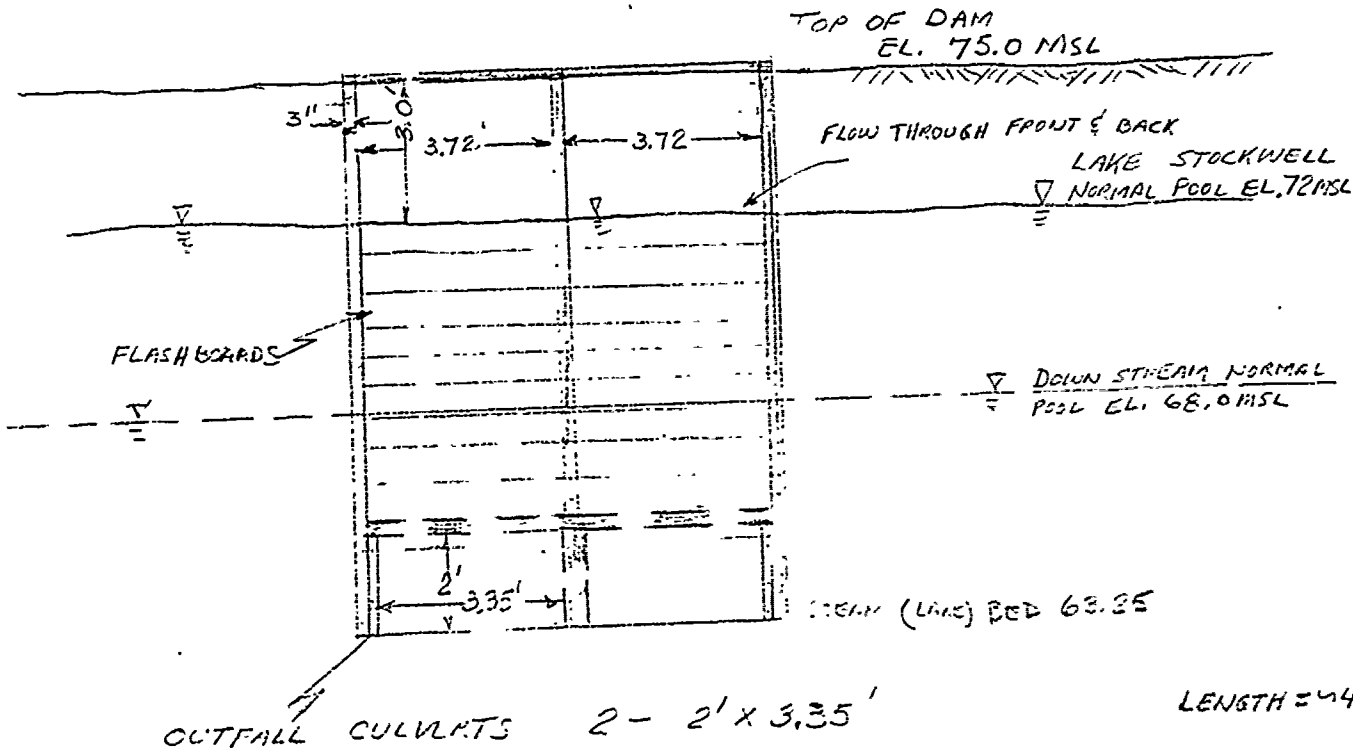
LOUIS BERGER & ASSOCIATES INC.

LAKE STOCKWELL DAM

SPILLWAY CALCULATIONS

SHEET NO. A5 OF _____

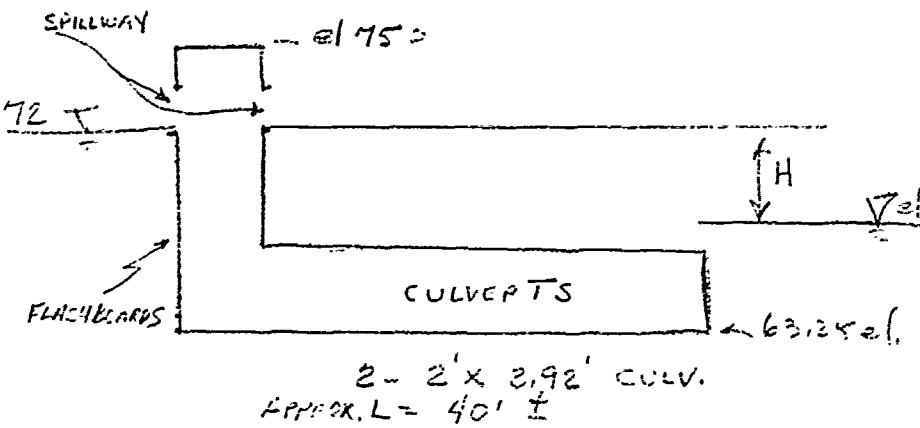
PROJECT C246



BY J.C. DATE 12/1/79 **LOUIS BERGER & ASSOCIATES INC.** SHEET NO. A6 OF

CHKD. BY DATE LAKE STOCKWELL DAM PROJECT C246

SUBJECT SPILLWAY ANALYSIS



2 - 2' x 2.92' CULV.
APPROX. L = 40' ±

- BOX CULVERTS ANALYSIS:

TREATING THE CULV. AS SUBMERGED ORIFICES & USING

$$Q = Ca\sqrt{2gH}$$

WHERE C = .78 FROM TABLE 4-11 KING'S HANDBOOK HYDRAULICS

where $r = 13.4/21.4 = .63$ & L = 40'

H = Const. + 4' - ASSUMED - SINCE POOL EL. IN DOWNSTREAM POOL WILL APPROX. RISE AS THAT IN LAKE STOCKWELL.

$$Q = .78 \times 13.4\sqrt{64.4 \times 4} = 168 \text{ cfs}$$

CONSTANT RATE ONCE CULVERT STANDPIPE IS FULL

BY J.C. DATE 12-79 **LOUIS BERGER & ASSOCIATES INC.** SHEET NO. A7 OF

CHKD. BY DATE STORMWELL LAKE DAM PROJECT

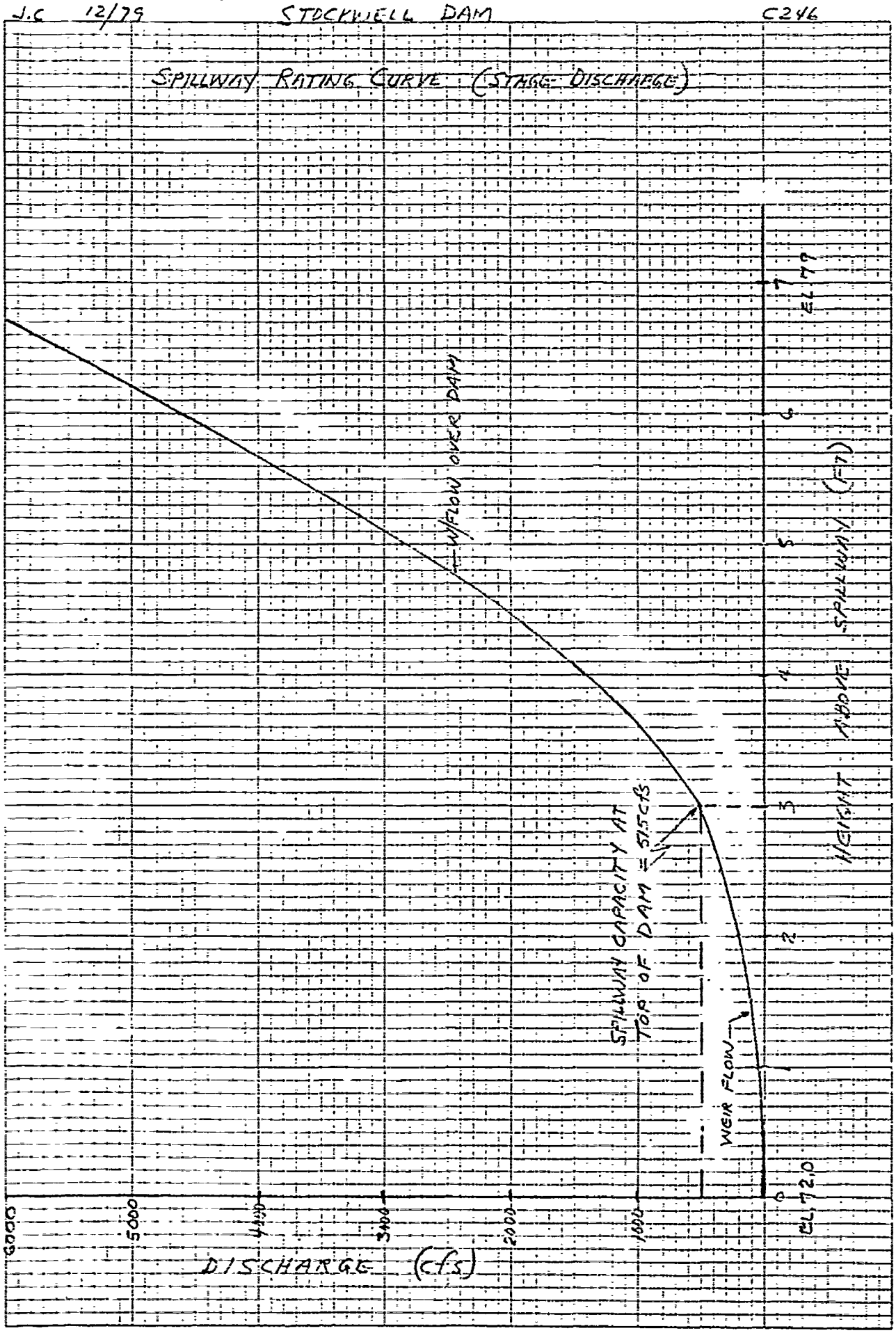
SUBJECT SPILLWAY CAPACITY CALCULATIONS

SPILLWAY CAPACITY

	SHARP CRESTED WEIR $C=3.3, L=14.9$ $Q=CLH^{3/2}$				HORIZONTAL ORIFICE $C=.6$ $Q=29.8^{11}$ $Q=CA\sqrt{2gH}$		CULVERT FLOW $C=.78, A=13.4^{FT}$		DAM & ROAD OVERFLOW BROAD CRESTED WEIR $Q=CLH^{3/2}$						ΣQ
									$C=2.7$ $L=190$ AT OUTFLOW			$L=70$ LOW PT IN RD.			
ELEV	H	L	C	Q	H	Q	ΔH	Q	H	C	Q	H	C	Q	
72															
73	1	14.9	3.3	49	1	~~119~~									49
74	2	14.9	3.3	139	2 (DOES NOT GOVERN)							.5	2.7	67	206
74.5	2.5	"	"	~~194~~			4	168				1	"	189	357
TOP OF DAM 75							4	168				1.5	"	347	515
76							"	168	1	2.7	513	2.5	"	747	1428
77							"	168	2	"	1451	3.5	"	1238	2857
78							"	169	3	"	2666	4.5	"	1804	4638
79							"	168	4		4104	5.5		2438	6541
80							"	168	5		5735	6.5		3132	8867

L = EFFECTIVE LENGTH OPENINGS ON BOTH SIDES

J.C 12/79 STOCKWELL DAM C246



46 0706

BY L.B DATE 12/79 **LOUIS BERGER & ASSOCIATES INC.** SHEET NO. A9 OF

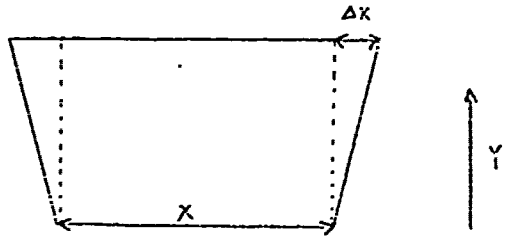
CHKD. BY J.C. DATE LAKE STOCKWELL DAM PROJECT C-246

SUBJECT SURCHARGE STORAGE

SURCHARGE STORAGE

area of lake @ El. 72 = 23 acres

area of 80' contour = 104 acres



Increment in volume. $\Delta V = (X + \Delta X)Y$

HEIGHT ABOVE SPILLWAY CREST	SURCHARGE STORAGE (ACRE-FEET)
0	0
1	28
2	66
3	115
4	173
5	242
6	320
7	409
8	508
9	617
10	736
11	866

J.C. 12/72 LAKE STOCKWELL A-10

STAGE - STORAGE CURVE

SURCHARGE STORAGE (ACRE-FT.)

800
600
400
200

0 2 4 6 8 10 12

EL. 720

HEIGHT ABOVE SPILLWAY

BY. J.C DATE 12/79 **LOUIS BERGER & ASSOCIATES INC.** SHEET NO. All OF.....

CHKD. BY..... DATE..... LAKE STOCKWELL DAM PROJECT.....

SUBJECT..... APPROXIMATE DRAWN

DRAINAGE AREA ; 3.5 S.M. + .46 = ~ 4 S.M.
VOL STORAGE BELOW NORMAL POOL: 72 MSL — 61 AC.FT.

DRAWDOWN : FROM ELEV. 72 TO 63.25 (STR. BED) ASSUMING THE LOWER (SMALL) LAKE IS DRAWN DOWN ALSO

REMOVE FLASHBOARDS & FLOW WILL BE CONTROLLED BY LOWER CULVERTS 2 — 2 x 3.8±

DRAWDOWN IN TWO STAGES :

1 SUBMERGED CULVERT OUTFLOW
FROM EL 72 TO 65.25 (TOP OF CULV)

$Q = Ca\sqrt{2gH}$ where $C = .78$, $a = 13.4$ sq ft
MAX H = ~ 4'
AVG H = 2' ASSUMED

$Q = .78 \times 13.4 \times \sqrt{64.4 \times 2}$
$Q = 119$ cfs FROM (72 — 65.25)
STORAGE VOL - ASSUME ~ 60 AC.FT.

ASSUME INLOW = 2 cfs/SM. = 2 x 4 = 8 cfs
∴ OUTFLOW = 111 cfs

DRAWDOWN TIME = $\frac{60 \times 43560}{1 \times 3600} = \underline{6.6 \text{ HOURS}}$

2 FROM EL. 65.25 TO 63.25 (STREAMBED ELEV.)
CULVERT FLOW - NOT SUBMERGED
USING INLET CONTROL - ASSUMING NO TAILWATER
HYDRAULIC CHARTS FOR HIGHWAY CULVS HYD ENG CIRC #5 BPR

AVG H = 1' $H_w/D = 1/3.92 = .26$ FROM CHART 1
1.7 /FT WIDTH $Q = 1.7 \times 2.35 + 1.7 \times 3.35 = 11.4$ cfs

ASSUME INFLOW = 2 cfs/SM = 8
∴ OUTFLOW = 4.4 cfs
STORAGE VOL = 1 AC.FT.
DRAWDOWN TIME = $\frac{1 \times 43560}{4.4 \times 3600} = \underline{2.75 \text{ HRS}}$

Σ DRAWDOWN = 9.25 SAY 10 HOURS

BY J. B. DATE

CHKD. BY DATE

LOUIS BERGER & ASSOCIATES INC.

SHEET NO. A12 OF

MEDFORD LAKES DAM INSPECTION

PROJECT C-446

SUBJECT UPPER STOKES DAM

MEDFORD LAKES DAM INSPECTION - STOKES, STOCKWELL, UPPER& LOWER AETNA LAKES
BY L BAINES
MARCH, 1980

JOB SPECIFICATION

NO	NMP	NMIN	IDAY	IHR	IMIN	METRC	IPLT	IPPT	NSTAN
150	0	15	0	0	0	0	0	0	0

JOPER	NQT
3	0

SUB-AREA RUNOFF COMPUTATION

INFLOW TO STOKES LAKE

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME
1	0	0	0	0	0	1

HYDROGRAPH DATA

IHYDG	IUHG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
0	-1	1.55	0.00	1.55	0.00	0.000	0	0	0

PRECIP DATA

NP	STORM	DAD	DAR
24	0.00	0.00	0.00

PRECIP PATTERN

0.06	0.06	0.06	0.06	0.07	0.07	0.08	0.09	0.09	0.09
0.11	0.11	0.30	0.70	1.70	0.40	0.40	0.20	0.16	0.14
0.37	0.06	0.06	0.06						

LOSS DATA

STRKR	STRTR	RTIOL	ERAIN	STRKS	RTIOK	STRTL	CNSTL	ALSMX	RTIMP
0.30	0.00	1.00	0.00	0.00	1.00	0.50	0.10	0.00	0.00

GIVEN UNIT GRAPH, NUHOG= 11

225	705	1039	791	473	297	178	105.	65	39
25									

UNIT GRAPH TOTALS 4022. CFS OR 1.01 INCHES OVER THE AREA

RECESSION DATA

STRTQ= 0.00 QRCSN= 0.00 RTIOR= 1.00

END-OF-PERIOD FLOW

TIME	RAIN	EXCS	COMP Q
1	0.06	0.00	0.
2	0.06	0.00	0
3	0.06	0.00	0.
4	0.06	0.00	0
5	0.07	0.00	0
6	0.07	0.00	0
7	0.08	0.00	0.
8	0.09	0.04	8.
9	0.09	0.07	43.
10	0.09	0.07	103.
11	0.11	0.08	166.

BY. L.B. DATE

CHKD. BY. DATE

LOUIS BERGER & ASSOCIATES INC.

MEDFORD LAKES DAM INSPECTION

SHEET NO. A13 OF

PROJECT C-246

SUBJECT UPPER STOKES DAM

12	0.11	0.06	222.
13	0.20	0.17	310
14	0.70	0.67	580.
15	1.79	1.67	1035
16	0.40	0.38	2404
17	0.40	0.38	2936
18	0.20	0.18	2481.
19	0.16	0.13	1914
20	0.14	0.12	1445
21	0.07	0.04	1060
22	0.04	0.03	763.
23	0.06	0.03	537
24	0.04	0.03	379.
25	0.00	0.00	270.
26	0.00	0.00	164
27	0.00	0.00	100.
28	0.00	0.00	55.
29	0.00	0.00	31
30	0.00	0.00	17
31	0.00	0.00	8.
32	0.00	0.00	5.
33	0.00	0.00	2.
34	0.00	0.00	1.
35	0.00	0.00	0.
36	0.00	0.00	0.
37	0.00	0.00	0.
38	0.00	0.00	0.
39	0.00	0.00	0
40	0.00	0.00	0.
41	0.00	0.00	0
42	0.00	0.00	0.
43	0.00	0.00	0.
44	0.00	0.00	0.
45	0.00	0.00	0
46	0.00	0.00	0
47	0.00	0.00	0
48	0.00	0.00	0.
49	0.00	0.00	0.
50	0.00	0.00	0
51	0.00	0.00	0.
52	0.00	0.00	0.
53	0.00	0.00	0
54	0.00	0.00	0.
55	0.00	0.00	0.
56	0.00	0.00	0.
57	0.00	0.00	0.
58	0.00	0.00	0
59	0.00	0.00	0
60	0.00	0.00	0
61	0.00	0.00	0.
62	0.00	0.00	0.
63	0.00	0.00	0
64	0.00	0.00	0
65	0.00	0.00	0
66	0.00	0.00	0
67	0.00	0.00	0
68	0.00	0.00	0
69	0.00	0.00	0
70	0.00	0.00	0
71	0.00	0.00	0
72	0.00	0.00	0
73	0.00	0.00	0
74	0.00	0.00	0
75	0.00	0.00	0
76	0.00	0.00	0
77	0.00	0.00	0.
78	0.00	0.00	0
79	0.00	0.00	0
80	0.00	0.00	0.
81	0.00	0.00	0
82	0.00	0.00	0
83	0.00	0.00	0.
84	0.00	0.00	0.
85	0.00	0.00	0
86	0.00	0.00	0
87	0.00	0.00	0
88	0.00	0.00	0.
89	0.00	0.00	0
90	0.00	0.00	0
91	0.00	0.00	0
92	0.00	0.00	0.
93	0.00	0.00	0.
94	0.00	0.00	0.
95	0.00	0.00	0
96	0.00	0.00	0.
97	0.00	0.00	0.
98	0.00	0.00	0.
99	0.00	0.00	0.
100	0.00	0.00	0.
101	0.00	0.00	0.
102	0.00	0.00	0.
103	0.00	0.00	0.
104	0.00	0.00	0.
105	0.00	0.00	0.
106	0.00	0.00	0.
107	0.00	0.00	0
108	0.00	0.00	0.
109	0.00	0.00	0
110	0.00	0.00	0
111	0.00	0.00	0.
112	0.00	0.00	0
113	0.00	0.00	0
114	0.00	0.00	0
115	0.00	0.00	0.
116	0.00	0.00	0.
117	0.00	0.00	0
118	0.00	0.00	0
119	0.00	0.00	0
120	0.00	0.00	0
121	0.00	0.00	0
122	0.00	0.00	0
123	0.00	0.00	0
124	0.00	0.00	0.
125	0.00	0.00	0
126	0.00	0.00	0
127	0.00	0.00	0
128	0.00	0.00	0
129	0.00	0.00	0
130	0.00	0.00	0.
131	0.00	0.00	0.
132	0.00	0.00	0
133	0.00	0.00	0
134	0.00	0.00	0
135	0.00	0.00	0
136	0.00	0.00	0
137	0.00	0.00	0
138	0.00	0.00	0
139	0.00	0.00	0
140	0.00	0.00	0.
141	0.00	0.00	0.
142	0.00	0.00	0.
143	0.00	0.00	0.

BY L.B. DATE

CHKD. BY DATE

SUBJECT UPPER STOKES DAM

LOUIS BERGER & ASSOCIATES INC.

MEDFORD LAKES DAM INSPECTION

SHEET NO. A14 OF

PROJECT C-246

144	0.00	0.00	0.
145	0.00	0.00	0
146	0.00	0.00	0
147	0.00	0.00	0
148	0.00	0.00	0
149	0.00	0.00	0
150	0.00	0.00	0
SUM	5.20	4.27	17239

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	2636	713	180	115	17239
INCHES		4.31	4.31	4.31	4.31
AC-FT		356	356	356.	356

HYDROGRAPH ROUTING

ROUTING THROUGH STOKES LAKE

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME
0	1	0	0	0	0	1

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME
0.0	0.000	0.00	1	0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA
1	0	0	0.000	0.000	0.000	0.

STORAGE=	0	9.	18.	31.	46	63	82.	103.	126.	152.
OUTFLOW=	0	16	57	769	2059	3724	5695	7928.	10397.	13079

TIME	EOP STOR	AVG IN	EOP OUT
1	0	0	0
2	0	0	0
3	0	0	0
4	0	0	0.
5	0	0	0
6	0	0	0
7	0	0.	0
8	0	4.	0.
9	1	26	1
10	2	73.	4
11	5.	135	9.
12	8	194.	18
13	13	266.	38.
14	20.	445.	131.
15	31.	957.	712
16	43.	1669.	1795.
17	52	2620	2607.
18	52	2658.	2659
19	47	2148.	2195
20	42.	1679.	1701.
21	37.	1252.	1279.
22	33.	912	937.
23	30	650	690.
24	26	458.	522
25	24	325.	379.
26	22	217	262
27	20	132.	168.
28	19	77.	102
29	18.	43.	60
30	17.	24	51
31	17.	13.	51.

LOUIS BERGER & ASSOCIATES INC.

32	16	6.	47.	98	1	0.	2.
33	15.	3.	44	99	1.	0.	2.
34	14.	2.	40.	100	1	0.	2.
35	13	0.	37.	101	1.	0.	2.
36	12.	0	34.	102	1.	0.	2.
37	12.	0.	31.	103	1.	0.	1.
38	11	0.	29.	104	1.	0.	1.
39	11	0	26.	105	1.	0.	1.
40	10.	0.	24.	106	1.	0.	1.
41	10	0.	22.	107	1.	0.	1.
42	9	0.	21.	108	1.	0.	1.
43	9	0.	19.	109	1	0.	1
44	8	0.	17.	110	1.	0.	1.
45	8.	0.	16.	111	1	0.	1.
46	8	0	15.	112	1.	0.	1.
47	7.	0	15.	113	0	0.	1.
48	7.	0.	14.	114	0.	0.	1.
49	7.	0	14	115	0.	0.	1
50	6	0.	13.	116	0	0.	1.
51	6.	0.	12.	117	0.	0.	1.
52	6	0.	12.	118	0.	0.	1.
53	6	0.	11.	119	0	0.	1.
54	5.	0.	11.	120	0	0.	1.
55	5	0.	11	121	0.	0.	1.
56	5.	0.	10.	122	0	0.	1.
57	5.	0.	10	123	0.	0.	1.
58	5	0.	9.	124	0.	0.	1.
59	4.	0.	9.	125	0	0.	1.
60	4	0	9.	126	0.	0.	1.
61	4	0	8	127	0.	0.	1.
62	4.	0.	8	128	0	0.	1.
63	4.	0.	8	129	0.	0.	0.
64	4.	0.	7.	130	0.	0.	0.
65	3.	0.	7.	131	0.	0.	0.
66	3	0.	7.	132	0	0.	0.
67	3.	0.	6	133	0.	0.	0
68	3.	0.	6.	134	0.	0.	0.
69	3.	0	6.	135	0.	0.	0.
70	3	0.	6	136	0.	0.	0.
71	3	0.	5	137	0.	0.	0.
72	3.	0.	5.	138	0.	0.	0.
73	3.	0	5.	139	0.	0.	0.
74	2.	0	5	140	0.	0.	0.
75	2.	0.	5	141	0.	0	0.
76	2	0.	4.	142	0.	0.	0.
77	2.	0	4	143	0.	0.	0
78	2.	0.	4	144	0.	0.	0.
79	2.	0.	4	145	0.	0.	0.
80	2	0.	4	146	0	0.	0
81	2.	0.	4.	147	0.	0.	0
82	2.	0.	3	148	0	0.	0.
83	2	0.	3	149	0	0.	0.
84	2	0.	3.	150	0	0.	0
85	2	0	3.				
86	1.	0	3.	SUM			17234.
87	1.	0.	3.				
88	1	0.	3		PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
89	1.	0.	3	CFS	2659	693	179	115	17234
90	1.	0.	2.	INCHES		4.16	4.30	4.31	4.31
91	1	0.	2.	AC-FT		344	356.	356.	356
92		0.	2.						
93	1	0	2.						
94	1.	0.	2.						
95	1	0.	2.		**********	**********	**********		
96	1.	0	2.						
97	1.	0.	2.						

SUB-AREA RUNOFF COMPUTATION

LOUIS BERGER & ASSOCIATES INC.

INFLOW TO LAKE STOCKWELL

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME
2	0	0	0	0	0	1

HYDROGRAPH DATA

IHYDG	IUHG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
0	-1	3.50	0.00	3.50	0.00	0.000	0	0	0

PRECIP DATA

NP	STORM	DAD	DAK
24	0.00	0.00	0.00

PRECIP PATTERN

0.06	0.06	0.06	0.06	0.07	0.07	0.08	0.09	0.09	0.09
0.11	0.11	0.30	0.70	1.70	0.40	0.40	0.20	0.16	0.14
0.07	0.06	0.06	0.06						

LOSS DATA

STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOK	STRTL	CNSTL	ALSMX	RTIMP
0.00	0.00	1.00	0.00	0.00	1.00	0.50	0.10	0.00	0.00

GIVEN UNIT GRAPH, NUHGO= 19

116.	436.	916.	1293.	1405.	1250.	984.	709.	534.	402.
299.	214.	157.	117.	83.	65.	48.	37.	25.	

UNIT GRAPH TOTALS 9100. CFS OR 1.01 INCHES OVER THE AREA

RECESSION DATA

STRTQ= 0.00 QRCSN= 0.00 RTIOR= 1.00

END-OF-PERIOD FLOW

TIME	RAIN	EXCS	COMP Q
1	0.06	0.00	0.
2	0.06	0.00	0.
3	0.06	0.00	0.
4	0.06	0.00	0.
5	0.07	0.00	0.
6	0.07	0.00	0.
7	0.08	0.00	0.
8	0.09	0.04	4.
9	0.09	0.07	23.
10	0.09	0.07	69.
11	0.11	0.08	144.
12	0.11	0.08	241.
13	0.30	0.27	368.
14	0.70	0.67	594.
15	1.70	1.67	1141.
16	0.40	0.38	2103.
17	0.40	0.38	3286.
18	0.20	0.18	4203.
19	0.16	0.13	4552.
20	0.14	0.12	4317.
21	0.07	0.04	3764.
22	0.06	0.03	3111.
23	0.06	0.03	2548.
24	0.06	0.03	2048.
25	0.00	0.00	1624.
26	0.00	0.00	1267.
27	0.00	0.00	979.
28	0.00	0.00	749.
29	0.00	0.00	564.
30	0.00	0.00	418.
31	0.00	0.00	307.
32	0.00	0.00	223.
33	0.00	0.00	150.
34	0.00	0.00	79.
35	0.00	0.00	51.

BY L.B. DATE

CHKD. BY DATE

SUBJECT LAKE STOCKWELL DAM

LOUIS BERGER & ASSOCIATES INC.

MEDFORD LAKES DAM INSPECTION

SHEET NO. A17 OF

PROJECT C-246

36	0.00	0.00	30.
37	0.00	0.00	19.
38	0.00	0.00	12.
39	0.00	0.00	6
40	0.00	0.00	4
41	0.00	0.00	2.
42	0.00	0.00	1.
43	0.00	0.00	0.
44	0.00	0.00	0
45	0.00	0.00	0.
46	0.00	0.00	0
47	0.00	0.00	0.
48	0.00	0.00	0.
49	0.00	0.00	0.
50	0.00	0.00	0.
51	0.00	0.00	0.
52	0.00	0.00	0.
53	0.00	0.00	0.
54	0.00	0.00	0.
55	0.00	0.00	0.
56	0.00	0.00	0.
57	0.00	0.00	0.
58	0.00	0.00	0.
59	0.00	0.00	0.
60	0.00	0.00	0.
61	0.00	0.00	0.
62	0.00	0.00	0.
63	0.00	0.00	0.
64	0.00	0.00	0.
65	0.00	0.00	0.
66	0.00	0.00	0.
67	0.00	0.00	0.
68	0.00	0.00	0.
69	0.00	0.00	0.
70	0.00	0.00	0.
71	0.00	0.00	0.
72	0.00	0.00	0.
73	0.00	0.00	0.
74	0.00	0.00	0.
75	0.00	0.00	0.
76	0.00	0.00	0.
77	0.00	0.00	0
78	0.00	0.00	0.
79	0.00	0.00	0.
80	0.00	0.00	0.
81	0.00	0.00	0.
82	0.00	0.00	0.
83	0.00	0.00	0
84	0.00	0.00	0.
85	0.00	0.00	0.
86	0.00	0.00	0
87	0.00	0.00	0.
88	0.00	0.00	0.
89	0.00	0.00	0
90	0.00	0.00	0.
91	0.00	0.00	0
92	0.00	0.00	0
93	0.00	0.00	0
94	0.00	0.00	0
95	0.00	0.00	0
96	0.00	0.00	0
97	0.00	0.00	0
98	0.00	0.00	0.
99	0.00	0.00	0.
100	0.00	0.00	0
101	0.00	0.00	0.

102	0.00	0.00		0
103	0.00	0.00		0.
104	0.00	0.00		0.
105	0.00	0.00		0.
106	0.00	0.00		0.
107	0.00	0.00		0.
108	0.00	0.00		0.
109	0.00	0.00		0.
110	0.00	0.00		0.
111	0.00	0.00		0.
112	0.00	0.00		0.
113	0.00	0.00		0.
114	0.00	0.00		0.
115	0.00	0.00		0.
116	0.00	0.00		0.
117	0.00	0.00		0.
118	0.00	0.00		0.
119	0.00	0.00		0.
120	0.00	0.00		0.
121	0.00	0.00		0.
122	0.00	0.00		0.
123	0.00	0.00		0.
124	0.00	0.00		0.
125	0.00	0.00		0.
126	0.00	0.00		0.
127	0.00	0.00		0.
128	0.00	0.00		0.
129	0.00	0.00		0.
130	0.00	0.00		0.
131	0.00	0.00		0.
132	0.00	0.00		0.
133	0.00	0.00		0.
134	0.00	0.00		0.
135	0.00	0.00		0.
136	0.00	0.00		0.
137	0.00	0.00		0.
138	0.00	0.00		0.
139	0.00	0.00		0.
140	0.00	0.00		0.
141	0.00	0.00		0.
142	0.00	0.00		0.
143	0.00	0.00		0.
144	0.00	0.00		0.
145	0.00	0.00		0.
146	0.00	0.00		0.
147	0.00	0.00		0.
148	0.00	0.00		0
149	0.00	0.00		0.
150	0.00	0.00		0.
SUM	5.20	4.27		39001.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	4552	1016	406	260	39004
INCHES		4.29	4.32	4.32	4.32
AC-FT		202.	806	806.	806.

********** ********** **********

COMBINE HYDROGRAPHS

COMBINE ROUTED HYD STORES OWN + INFLOW HYD. TO STOCYVE

ISTAQ	ICOMP	ICOMN	ITAPE	JPLT	JPRT	INAME
22	2	0	0	0	0	1

SUM OF 2 HYDROGRAPHS AT 22

0	0.	0	0	0	0	0.	4.	24.	73
154	259	405	775	1603.	3890.	5893	6662	6747	6018
5043	4044	3239	2571.	2003	1530	1147	852.	623.	472.
336	211	193	120.	98	65	51.	40.	33.	23
24	21.	19	17	16	15	15	14	13	13
12	12	11	11.	11	10	10.	9.	9.	9
7	7	6	7	7	7	6	6	6.	6
5	5	5	5	5	4	4.	4	4	4
3	3	3	3	3	3.	3.	3	3	2
2	2	2	2	2.	2.	2	2.	2.	2
2	2.	1	1	1	1	1.	1.	1	1
1	1	1.	1.	1	1.	1.	1.	1	1
1	1	1.	1	1	1.	1.	1.	0	0
0	0	0	0	0	0.	0.	0.	0.	0
0	0.	0.	0	0	0.	0.	0.	0.	0

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	6662	2307.	595	375	56257.
INCHES		4.25	4.31	4.32	4.32
AC-FT		1144	1162.	1162	1163.

HYDROGRAPH ROUTING

ROUTING THROUGH LAKE STOCKWELL -

ISTAO	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME
222	1	0	0	0	0	1

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME
0.0	0.000	0.00	1	0

NSTPS	NSTOL	LAG	AMSKK	X	TSK	STORA
1	0	0	0.000	0.000	0.000	0.

STORAGE=	0.	20	66.	115.	173	242.	320.	409.	508.	0.
OUTFLOW=	0	49.	206	515.	1428.	2857.	4638.	6541.	8867.	0

TIME	EOP STOR	AVG IN	EOP OUT
1	0	0.	0.
2	0	0.	0
3	0	0	0
4	0.	0.	0.
5	0.	0.	0.
6	0	0.	0
7	0.	0.	0.
8	0	2.	0.
9	0	14.	1.
10	1	49.	2.
11	4	113.	3.
12	9	206.	13.
13	14	332.	25.
14	26	590.	45.
15	51.	1329	144.
16	105	2890.	450
17	194	4995.	1057.
18	264.	6377.	3359.
19	322.	6304.	4672.
20	351	6383.	5291.
21	355	5530.	5370

BY L.B. DATE

CHKD. BY DATE

SUBJECT

LOUIS BERGER & ASSOCIATES INC.

METEOR LAKES DAM INSPECTION

SHEET NO. A20 OF

PROJECT C-234

23	316	3642	4551.
24	280.	3305.	3923
25	261	2337.	3099
26	236	1766.	2705.
27	212.	1338	2230
28	191	1000.	1660
29	173.	709	1420
30	157	548.	1180.
31	144	415.	969.
32	132	314.	784
33	122	232.	630
34	114	157.	507.
35	106.	104.	458.
36	99	76.	411.
37	92.	58.	368.
38	85	45.	329.
39	80	37	293
40	75	30.	261
41	70.	26.	232
42	66	23.	206.
43	62	20	191.
44	59.	18.	177.
45	56	17.	164.
46	53.	16.	152.
47	50	15.	140.
48	48.	14.	130.
49	45	14.	121
50	43.	13.	112.
51	41	13.	104.
52	39.	12.	96
53	38.	12.	89
54	36.	11.	83.
55	35.	11.	77.
56	33.	10.	72.
57	32.	10.	66.
58	31	10.	62.
59	30.	9.	58.
60	29	9.	54.
61	28.	8.	50.
62	27.	8.	48.
63	27	8.	46.
64	26	7.	45.
65	25.	7.	44.
66	24.	7.	42.
67	24.	7.	41.
68	23	6.	40
69	22	6.	39.
70	21	6.	38
71	21	6.	36.
72	20	5.	35
73	20	5.	34.
74	19	5.	33
75	18	5.	32.
76	18	5	31
77	17.	4	30
78	17	4	29
79	16	4.	28.
80	16	4	28
81	15	4.	27
82	15	4	26
83	14	3.	25
84	14	3	24
85	13	3	24.
86	13	3	23.
87	13	3	22.
88	12.	3.	21.

BY L.B. DATE

CHKD. BY DATE

SUBJECT LAKE STOCKWELL DAM

LOUIS BERGER & ASSOCIATES INC.

MEDFORD LAKES DAM INSPECTION

SHEET NO. A21 OF

PROJECT C-24

91	12.	3.	21.	
92	11	3.	20.	
93	11	2.	19.	
94	11	2.	19	
95	10	2	18.	
96	10	2.	18	
97	10	2.	17.	
98	9	2.	17.	
99	9	2	16.	
100	9	2	16	
101	9	2	15	
102	8	2.	15.	
103	8	2.	14.	
104	8.	2.	14.	
105	8.	1.	13.	
106	7.	1.	13.	
107	7.	1.	12	
108	7.	1.	12.	
109	7.	1.	12.	
110	6.	1.	11.	
111	6.	1.	11.	
112	6	1.	10	
113	6	1.	10.	
114	5	1.	10.	
115	5.	1.	9.	
116	5.	1.	9.	
117	5	1.	9.	
118	5.	1.	8.	
119	5.	1.	8	
120	5	1.	8.	
121	4.	1.	8.	
122	4	1.	7.	
123	4	1.	7.	
124	4	1.	7.	
125	4	1.	7.	
126	4.	1.	6.	
127	4.	1.	6.	
128	3.	1.	6	
129	3.	1.	6.	
130	3.	1.	6.	
131	3.	0.	5.	
132	3.	0.	5	
133	3.	0.	5.	
134	3	0.	5.	
135	3.	0.	5.	
136	3	0.	5	
137	2.	0.	4.	
138	2.	0.	4	
139	2	0.	4.	
140	2	0.	4	
141	2.	0.	4	
142	2	0.	4.	
143	2.	0.	4.	
144	2.	0.	3.	
145	2.	0.	3.	
146	2	0.	3	
147	2	0.	3	
148	2	0	3.	
149	2.	0	3.	
150	2.	0.	3.	
SUM			56161.	

	PEAK	6-HOUR	24-HOUR	32-HOUR	TOTAL VOLUME
CFS	5378.	2157	582.	374.	56161.
INCHES		3.97	4.29	4.31	4.31
AC-FT		1070	1155	1161	1161.